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January 17, 2002

Ms. Magalie Roman Salas
Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, DC 20554

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JAN 17 2002

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

David E. Hilliard
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Re: ET Docket No. 98-153 - Ultra-Wideband
Ex Parte Notice

EX PARTE OR LATE FILED

Dear Ms. Salas:

On January 16, 2002, Jeffrey Ross and Paul Withington of Time Domain Corporation and I met with Julius Knapp, Deputy Chief of the Office of Engineering and Technology. We discussed the status of the Commission's rulemaking on Ultra Wideband. During the meeting, we provided Mr. Knapp with the enclosed draft rule pertaining to UWB emissions. The rule provides additional protection beyond that proposed in the Commission's Notice of Proposed Rule Making. A copy of the slides prepared for the meeting is also enclosed.

Pursuant to Section 1.1206 of the Commission's Rules, 47 C.F.R. §1.1206, an original and a copy of this letter have been submitted for inclusion in the public record. Please contact me at the phone number listed above if you have any questions concerning this letter.

Respectfully,

David E. Hilliard
Counsel for Time Domain Corporation

cc: Julius Knapp, Deputy Chief, OET

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TIME DOMAIN

THE PULSE OF THE FUTURE

UWB Limits

TIME DOMAIN®

1/16/2002

NPRM Proposed Levels Are Appropriate

- ▶ Testing shows levels are adequate to protect existing users
- ▶ Lower levels endanger viability of UWB

Our Proposal (1)

- ▶ **Emissions Mask**

<u>Frequency (MHz)</u>	<u>Field Strength ($\mu\text{V}/\text{meter}$ @ 3meters)</u>
<960 MHz	Limits set forth in §15.209(a)
960-2000	125
above 2000	500

- ▶ **Measurement**

May be made at less than 3 meters with the limits adjusted inversely proportional to distance.

RMS detector with a 1 MHz resolution BW.

- ▶ **Additional Protection Across Entire GPS L1 Band**

1574.42 – 1576.42 MHz at a level exceeding $45 \mu\text{V}/\text{m}$ at 3 meters when measured with a RMS detector with a 10 kHz RBW

Option to show device produces effects in GPS receivers equivalent to or less harmful than AGWN

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Our Proposal (2)

- ▶ Outdoor, Fixed Tracking and Radar
 - ▶ Entities eligible for licensing in the industrial and land transportation pool of frequencies under Part 90
 - ▶ Antennas mounted not more than three meters above ground with main lobe of the pattern is at an elevation angle of -5 degrees or lower.
- ▶ Public Safety Operation
 - ▶ Entities eligible for licensing in the public safety pool of frequencies set forth in Part 90
 - ▶ Use limited directly to preservation of life and/or property or training
 - ▶ Part 15 Class B limits
 - ▶ Additional Protection for GPS (165 μ V/m at 3 meters limit for bands 1574.42 – 1576.42 MHz with a 10 kHz resolution bandwidth)
 - ▶ Option to show device produces effects in GPS receiver equivalent or less harmful than AGWN
 - ▶ Nominal center frequency is above 2 GHz
 - ▶ Registration Requirement
- ▶ Additional Provisions for GPRs and Vehicular Radar

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This Protects “Sensitive” Systems

- ▶ **GPS**
 - ▶ JSC concluded results of three studies yielded very similar results
 - ▶ JHUAPL study shows GPS has sufficient protection for true safety-of-life applications
- ▶ **PCS**
 - ▶ Real data, not theory, shows interference range less than 1 foot
- ▶ **Radars**
 - ▶ Realistic analyses show neither a single device nor aggregation of devices could cause interference

The Difference Between Theory & Practice

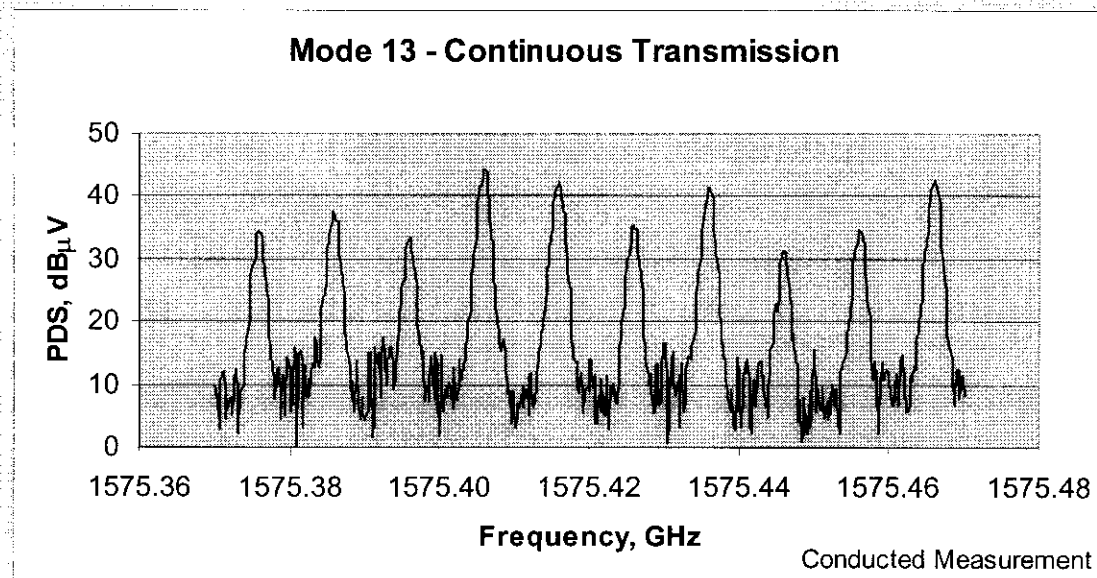
- ▶ Anti-UWB forces rely on simplistic theoretical models
 - ▶ Conducted measurements
 - ▶ Unrealistic propagation models
 - ▶ Unknown performance baselines
- ▶ Real-world testing demonstrates insufficiency of these simplistic models

GPS

- ▶ 100 foot aviation safety criteria protected at full Part 15 Class B level
 - ▶ NPRM protection provides
- ▶ 10 dB reduction for narrowband lines more than adequate

Don't Demand Further Reductions For Narrowband Emissions

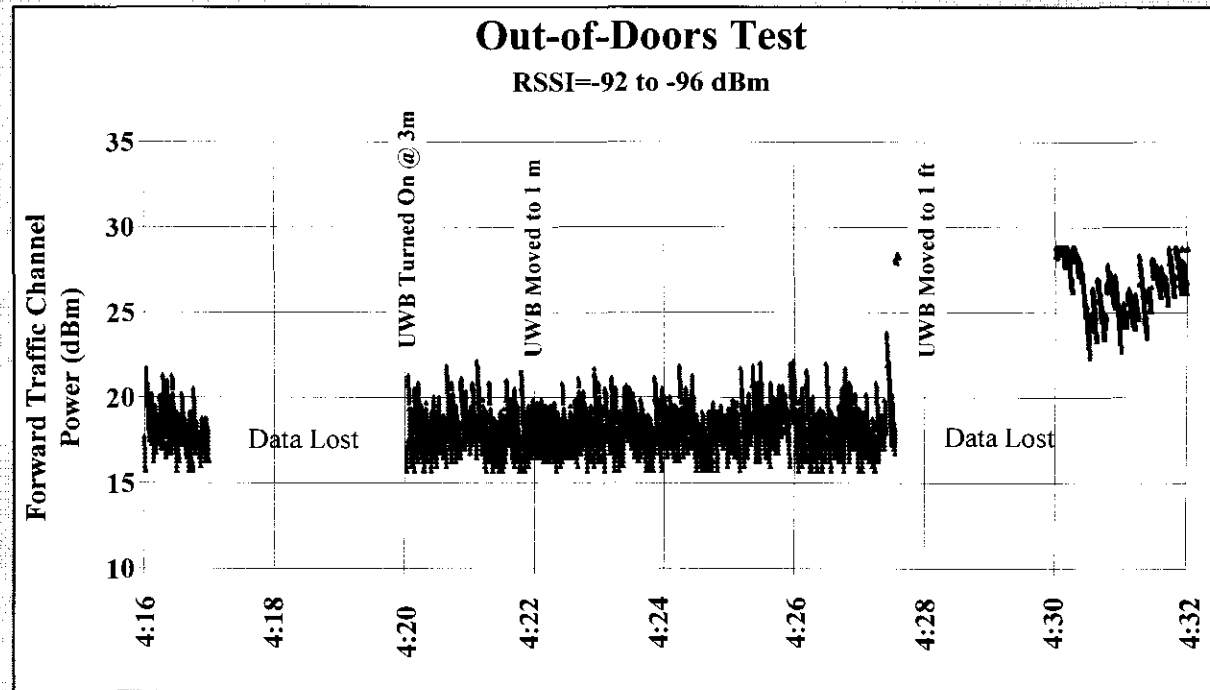
- ▶ GPS testing at ARL:UT and analyzed by JHUAPL used UWB signal source that contained spectral lines at 9.6 kHz spacing
- ▶ JHUAPL still determined that the signals were noise-like, i.e., there was no 10 dB narrowband-like interference penalty
- ▶ White-noise-like impact is appropriate



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PCS Testing Shows No Harmful Interference

- ▶ PCS industry refuses to deal with real world data showing no interference from UWB device operating at full Part 15 Class B level until 1 foot separation



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NTIA Analyses of Radars Systems Were Inadequate

- ▶ TDC's & XSI's analyses shows when real world factors are considered Federal radars not endangered
- ▶ NTIA spectrum measurement data suggest there are already sufficient noise signals in these bands to prove NTIA analyses were unreasonably conservative

Satellite Audio Broadcast

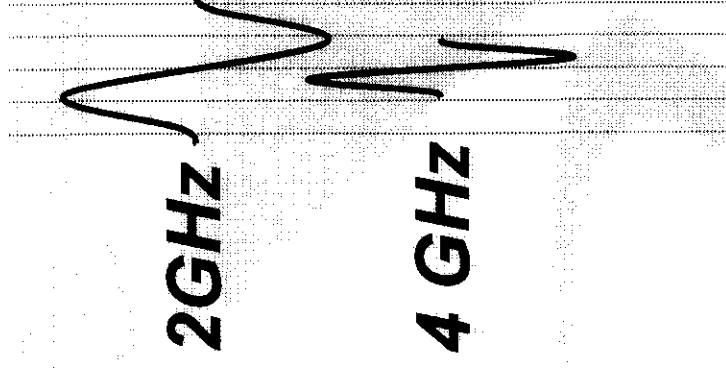
- ▶ Bands already shown by NTIA to be noisy yet industry treats UWB as if it would be the only source of noise
- ▶ Industry will rely on terrestrial transmissions for urban area coverage so satellite link budgets are inadequate to describe interaction with UWB

Complex Interactions

- ▶ Reducing emissions levels across a particular band forces filtering
 - ▶ Spreads signal in time
 - ▶ Makes construction of matched filter receiver much more difficult
 - ▶ Reduces available signal power
- ▶ Increasing frequency of operation
 - ▶ Increase in propagation losses
 - ▶ Smaller antenna (less signal captured)
 - ▶ Shorter range
 - ▶ More expensive

Consider an Imaging Radar...

- ▶ If we half the pulse duration we must half the sampling interval
- ▶ To create a 2D image the amount of signal processing goes up by 4
- ▶ To create a 3D image, it goes up by 8 times

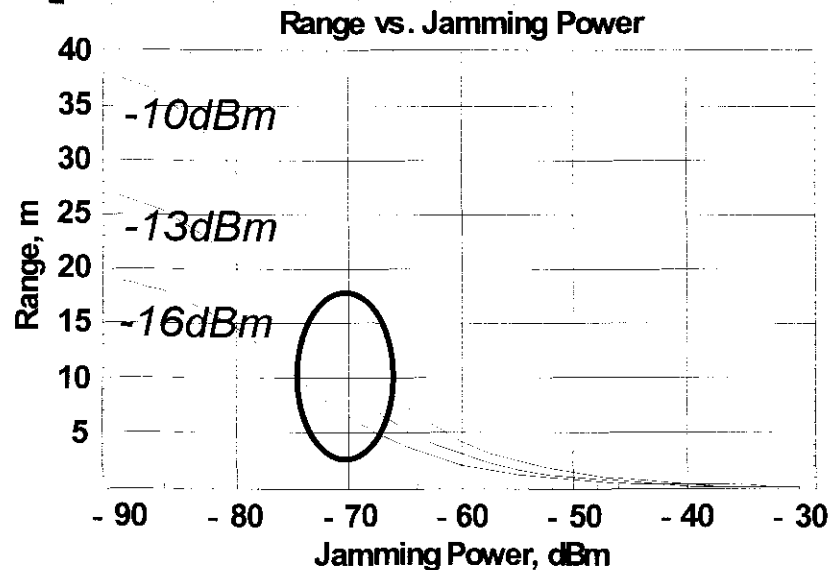


Lower Levels Endanger Viability of UWB

- ▶ UWB link budgets are very tight
- ▶ Reductions below NPRM levels leave systems more susceptible to emissions from other systems
- ▶ This susceptibility would constrain the range of UWB applications significantly

Don't Reduce Power Level

- ▶ In-band noise sources are significant
- ▶ Sufficient power is a key to reliable performance
- ▶ Reductions below NPRM limits will likely lead to insufficiently robust UWB system performance



Theoretical: 20 Mbps @ 10^{-3} with 10 dB for margin, system inefficiencies, free space propagation, and $f_c = 3$ GHz

Assume 5 meter separation

• **2.4 WLAN**

$$20 \text{ dBm} - 55 \text{ dB} = -35 \text{ dBm}$$

• **5.8 WLAN**

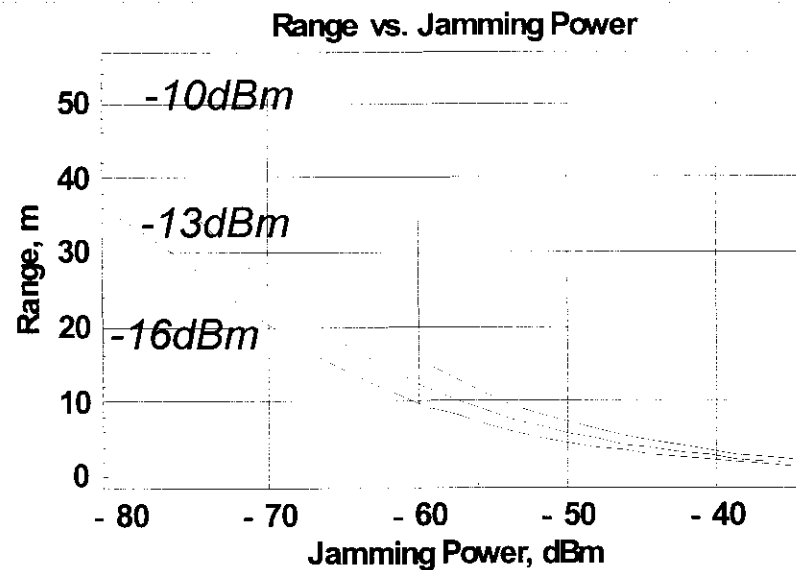
$$20 \text{ dBm} - 62 \text{ dB} = -42 \text{ dBm}$$

**More than processing gain is needed to overcome this deficit!
I.e., Signal processing and power**

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Don't Reduce Power Level!

- Firefighters can't afford to lose any power either....



Theoretical: 100 kbps @ 10^{-3} with 10 dB for margin, system inefficiencies, $1/R^3$ propagation, and $f_c = 3$ GHz

Impact of Reduced Power

- ▶ Radar sensors may be most endangered
 - ▶ Radar budget more demanding than for communications systems
 - ▶ UWB sensors may be impractical because sensing reliability will be diminished

15.____ Ultra-wideband Operation.

(a) Ultra-wideband devices as defined in Section 15.____ are authorized to operate under the following conditions:

(b)(1) Except as specifically provided in sub-paragraphs (c), (d), and (e) hereof, radiated emissions from ultra-wideband devices shall not exceed the following limits:

Frequency (MHz)	Field Strength (uV/meter@3meters)
<960 MHz	Limits set forth in §15.209(a)
960-2000	125
above 2000	500

- (i) Measurements may be made at less than 3 meters with the limits adjusted inversely proportional to distance. Measurements shall be performed using an RMS detector with a 1 MHz resolution BW.
- (ii) In addition to the limits set forth above, no ultra-wideband device shall radiate spectral lines in the band 1565.42 - 1585.42 MHz at a level exceeding 45 uV/m at 3 meters when measured with an RMS detector with a 10 KHz resolution bandwidth. In lieu of meeting this requirement, the applicant may provide measurement data showing its device produces effects in GPS receivers equivalent to or less detrimental than those produced by gaussian white noise at the power level that would produce field strength levels equivalent to those specified in subparagraph (b) (1)(i) above for the band 960 – 2000 MHz.
- (iii) Manufacturers of UWB devices must ensure the frequency stability such that the emissions profile specified in this sub-paragraph is maintained under all conditions of normal operation.

(2) No ultra-wideband device authorized under this sub-paragraph (b) may

- (i) have its radiating antenna mounted outdoors on any pole or surface unless such device is marketed exclusively for use by entities eligible for licensing in the industrial and land transportation pool of frequencies under Part 90 of this Chapter; and
- (ii) provided further that any such device marketed to such an entity shall have any outdoor radiating antenna mounted not more than three meters above ground with instructions provided specifying that the antenna must be such that the main lobe of the pattern is at an elevation angle of -5 degrees or lower.

(c)(1) Ultra-wideband devices marketed exclusively to entities eligible for licensing in the public safety pool of frequencies set forth in Part 90 of this Chapter will be authorized, provided that

(i) The radiated emissions from such devices do not exceed the limits set forth in Section 15.209(a) of this Chapter;

(ii) In addition to the limits set forth above, no ultra-wideband device shall radiate spectral lines in the band 1565.42 - 1585.42 MHz at a level exceeding 165 uV/m at 3 meters when measured with an RMS detector with a 10 kHz resolution bandwidth. In lieu of meeting this requirement, the applicant may provide measurement data showing its device produces effects in GPS receivers equivalent to or less detrimental than those produced by gaussian white noise at the power level that would produce field strength levels equivalent to those specified in sub-paragraph (c)(1)(i) for frequencies above 960 MHz.

(iii) The nominal center frequency, defined as the midpoint between the 3dB down frequencies on either side of the emission, of such devices is above 2000 MHz; and

(c)(2) The operation of devices authorized under this sub-paragraph is limited to uses directly related to the preservation of life and/or property or training directly related to such preservation.

(c)(3) Any public safety entity desiring to use an ultra-wideband device authorized under the provisions of this sub-paragraph (c) shall in advance of such operation register, with an entity designated by the Commission, the number of such devices, the FCC ID number associated with the device, the area of operation for such devices, and a representative who can be contacted in the event of reports of harmful interference that may be associated with the operation of such devices. The entity shall initially inform the operator of the device of the harmful interference report providing an opportunity to resolve the harmful interference and, when necessary to protect licensed services, exercise authority to order the termination of the operation of such devices until the interference complaint has been resolved.

(d) [provisions pertaining to ground penetrating radar devices]

(c) [provisions pertaining to or referencing the rules for 24 GHz vehicle radar]

NOTE: The footnote to Section 15.209 should be amended to include a reference to this rule pertaining to the authorization of UWB devices.

Antennas for UWB devices would either be integral, permanently attached, or attached using a unique connectors. See Section 15.203.